

Before the
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
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In the Matter of

The Establishment of Policies and Service
Rules for the Non-Geostationary
Satellite Orbit, Fixed Satellite Service
in the Ka-Band

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IB Docket No. 02-19 /

COMMENTS OF SKYBRIDGE

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SUMMARY

In the instant NPRM, the Commission explores various frameworks for facilitating sharing among multiple NGSO FSS systems in the Ka-band. “Option III” outlined by the Commission, which is based on avoidance of “in-line” interference events, is the only method proposed that meets all of the objectives articulated by the Commission in the NPRM. The other methods, based on either band segmentation or use of homogeneous constellation design, suffer from numerous problems that would impede rapid introduction of innovative services.

The options based on band segmentation do not guarantee licensees access to sufficient spectrum to support economically-viable operations. Moreover, they introduce a degree of uncertainty regarding the availability of bands, which may impose undesirable design constraints on the systems. Finally, by giving operators exclusive rights to spectrum vis-à-vis other NGSO operators, and by discouraging use of interference mitigation techniques, these methods also impede development by operators of more spectrum-efficient coordination agreements.

The options based on use of homogeneous constellations take critical business decisions away from the operators, and place them in the hands of the Commission. Requiring applicants to employ a “government-approved” constellation would thwart the business plans of many of the applicants.

Finally, because both of these options remove incentives for operators to implement interference mitigation capabilities, they would place the U.S.-licensed systems at a distinct disadvantage when serving regions or countries that have adopted alternative sharing regimes. These systems may not be able to meet the burden of sharing with foreign-licensed systems operating according to a different framework.

Option III, on the other hand, solves all of these problems. By taking advantage of the antenna discrimination inherent in all of the proposed NGSO FSS system designs, it permits each constellation to use all of the allocated spectrum during a great portion of the time. Moreover, the steps taken to reduce interference during “in-line” events between two or more satellites affect only those satellites; other satellites (and systems) may continue to use the entire band. At the same time, Option III does not require any of the applicants to depart from their proposed constellation designs, which allows the market, instead of the Commission, to dictate the services that are offered.

Furthermore, the technique offers full regulatory certainty. The Commission need not involve itself in administration of the regime once the framework is specified. At the same time, it encourages the operators to coordinate among themselves to achieve even greater spectrum efficiency.

Finally, it places the U.S.-licensed systems in an excellent position to provide service in foreign countries, no matter what sharing regime is employed by other administrations. Because the option inherently provides incentives for incorporation of mitigation techniques into systems, these capabilities can be put to use to share with foreign systems.

In sum, Option III provides each entrant equal access to the available spectrum, without requiring permanent and systematic reduction of the available spectrum to each operating NGSO FSS system, as in the options based on band segmentation. Furthermore, the option does not require operators to make fundamental system design changes that would sacrifice their technical and business plans, as in the case of enforced homogeneity. For these reasons, Option III is the only option that meets every one of the Commission’s stated objectives in this proceeding, and SkyBridge urges the Commission to proceed expeditiously to implement it.

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COMMENTS OF SKYBRIDGE

SkyBridge L.L.C. ("SkyBridge"), by its attorneys, hereby submits its comments in response to the Notice of Proposed Rulemaking¹ released in the above-captioned proceeding, which seeks to develop various service rules for non-geostationary satellite orbit ("NGSO") Fixed-Satellite Service ("FSS") systems in the Ka-band, including the rules for frequency sharing among multiple NGSO systems. SkyBridge has previously commented on many of these issues in similar proceedings related to sharing among Ku-band NGSO FSS systems.²

I. INTRODUCTION

In the NPRM, the Commission articulated a number of objectives for the NGSO/NGSO sharing framework. In particular, the Commission stated that the adopted rules should:

¹ FCC 02-30, rel. Feb. 6, 2002 (the "NPRM").

² See, e.g., In the Matter of The Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band, IB Docket No. 01-96, Comments of SkyBridge, July 6, 2001 ("SkyBridge Ku-Band Comments") and Reply Comments of SkyBridge, August 6, 2001 ("SkyBridge Ku-Band Reply Comments"). See also *Ex Parte* Presentation of SkyBridge, File Nos. 48-SAT-P/LA-97, 89-SAT-AMEND-97, 130-SAT-AMEND-98, Docket No. ET 98-206, March 27, 2001 ("SkyBridge March 27, 2001 *Ex Parte*"); *Ex Parte* Presentation of SkyBridge, IB Docket No. 01-96, January 31, 2002 ("SkyBridge January 31, 2002 *Ex Parte*").

- "provide incentives for prompt commencement of service to the public using state-of-the-art technology;"³
- "provide regulatory certainty to the NGSO FSS licensees;"⁴
- permit the Commission to license all second round applications on file;⁵
- ensure that NGSO FSS licensees each assume an equitable portion of the sharing burden;⁶
- "promote competition through opportunities for new entrants;"⁷
- "prevent spectrum warehousing by non-implemented NGSO FSS systems at the expense of operational systems;"⁸
- provide sufficient spectrum capacity for each system;⁹
- "not . . . preclude, in any way, the NGSO FSS systems' coordinated use of their spectrum assignments;"¹⁰
- achieve "an outcome dictated by the service market rather than by regulatory decision;"¹¹ and
- "establish a regulatory framework that does not favor any particular technology or operational method."¹²

SkyBridge agrees with the Commission that its adopted framework for sharing should ensure that all systems can potentially be accommodated, and should give

³ NPRM, ¶ 1.

⁴ Id., ¶ 16.

⁵ Id., ¶ 1.

⁶ Id., ¶ 13.

⁷ Id., ¶ 1.

⁸ Id., ¶ 15.

⁹ Id., ¶ 13.

¹⁰ Id., ¶ 16.

¹¹ Id., ¶ 2.

¹² Id., ¶ 13.

all of the applicants in the instant processing round an opportunity to launch and operate their systems, while taking responsibility for an equitable portion of the sharing burden. In particular, the solution must ensure that early entrants cannot thwart the ability of later systems to launch, while at the same time protecting against warehousing of spectrum. The sharing solution adopted also should be as generic as possible, so as not to confer a competitive advantage on any of the systems.¹³

¹³ In these comments SkyBridge does not distinguish between first round and second round licensees, but discusses sharing options in terms of their ability to equitably accommodate all proposed NGSO FSS. While the NPRM focuses on sharing among the second round Ka-band NGSO FSS applicants, it appears that the sole first round licensee, Teledesic, has lost any priority *vis-à-vis* the second round applicants to which it previously might have been entitled. Teledesic recently filed an application to modify its license, requesting authorization to change the constellation of its licensed system from 288 LEO satellites (reflecting an earlier reduction from 840) to 30 MEO satellites. Application of Teledesic LLC for Minor Modification of License to Construct, Launch, and Operate a Non-Geostationary Fixed Satellite System, SAT-MOD-20020201-00011, January 31, 2002. As noted in the NPRM, “modified systems that are significantly different from the system as authorized may be considered a new system and treated on equal footing with new or subsequent processing groups.” NPRM, at 7, n.36.

Moreover, as the Commission stated in a companion order to the NPRM: “If Teledesic were to significantly alter its system design at this point, it would indicate that Teledesic has not made the kind of progress that would limit its flexibility to incorporate design changes into its system. In this case, sharing the burden equally with new entrants may not impede its progress in implementing its system.” In the Matter of Teledesic Corporation Petition for Clarification An/Or Reconsideration, Memorandum Opinion and Order, CC Docket No. 92-297, rel. Feb. 6, 2002, ¶ 9. See also NPRM, ¶ 14. The recent modification request filed by Teledesic makes it clear that Teledesic has not progressed far in the construction of its system, and has significant flexibility at this stage to share equally the burden of coordination with new entrants.

The fact that Teledesic apparently executed a construction contract contemporaneously with the announcement of its proposal to switch to a 30 satellite MEO system is of no particular import. That contract was executed contemporaneously with the expiration of Teledesic’s first milestone deadline. In order to satisfy the milestone requirement, the contract would have to contemplate construction of spacecraft consistent with Teledesic’s existing (288 satellite LEO) license; a contract for a MEO satellite would not meet the milestone requirement. Thus, the fact that

The rules must also be consistent with the fact that all of the proposed systems require far more bandwidth than would be available with a simple segmentation of the allocated bands, particularly given the Commission's removal of certain secondary allocations for NGSO FSS in the Ka-band.¹⁴ Co-frequency sharing among the systems is therefore necessary to ensure their commercial viability. The sharing framework should facilitate, and indeed provide incentives for, individual coordination among the operators.¹⁵ At the same time, it must also provide a reasonable "default" solution that would govern sharing should systems for any reason be unable to achieve coordination agreements. The default solution should be simple and self-implementing, to avoid the need for the Commission to micro-manage the operation of the systems, but it must also guarantee each system sufficient spectrum to operate an economically viable system.

SkyBridge urges the Commission to adopt rules that reflect the fact that each of the NGSO applicants has selected a different constellation design, each of which

Teledesic may have a contract with a satellite manufacturer says nothing with respect to the maturity of its most recently proposed system design.

Finally, even assuming arguendo that Teledesic maintains first round status, this would not lessen its burden to take steps to share with the second round applicants. As a first round licensee, Teledesic's authorization requires it to "share the burden of coordination with other NGSO FSS systems and to coordinate in good faith." See NPRM, ¶ 6.

¹⁴ Capacity is strongly related to bandwidth; thus the amount of spectrum available to each system is a key element in the commercial viability of the systems. As discussed below, band segmentation to accommodate all the applicants would have a catastrophic impact on the commercial viability of the systems.

¹⁵ Coordination among applicants is the optimal method for sharing. As opposed to imposition of a generic sharing regime, coordination can take into account the specific features and flexibilities of each system, and thereby produce solutions that maximize capacity and minimize burdens for each system. Moreover, coordination permits the operators to maintain an equitable balance of constraints among the systems. However, the Commission's solution cannot depend on the expeditious development of a coordination agreement among all of the applicants.

is tailored to the particular market that the operator wishes to serve. These differences reflect legitimate business decisions, which the Commission's rules should not second-guess or undermine. For these reasons, the sharing framework should be technology neutral; i.e., it should neither favor any particular design, nor should it require any operator to modify the fundamental characteristics of its system or proposed services.

II. SPECTRUM SHARING OPTIONS

The Commission has proposed four alternative frameworks for NGSO/NGSO sharing. As discussed below, only Option III squarely meets all of the Commission's stated objectives in this proceeding. The other options suffer from a number of flaws. Chief among these, they: (1) fail to provide licensees certainty that they will have access to sufficient spectrum to support broadband services; (2) minimize or eliminate opportunities for more efficient coordination; and (3) impose design constraints on the systems that would adversely affect provision of innovative services.

A. Option I – Flexible Band Segmentation

Option I detailed in the NRPM would assign to each NGSO licensee a portion of spectrum for its exclusive use (vis-à-vis the other NGSO licensees). The available spectrum would be divided by the Commission into segments according to the number of applicants. Each licensee would select an available segment when it begins to launch its satellites. However, operating constellations would be permitted to employ unoccupied spectrum reserved for other NGSO FSS systems (either by coordinating such use, or subdividing equally the unoccupied spectrum).¹⁶

While this proposal would be simple to implement and, for the most part, treats all licensees equally, it fails to meet several of the most important Commission

¹⁶ NRPM, ¶ 19-20.

goals summarized above. First, it does not guarantee sufficient spectrum capacity for each system. The broadband services proposed by the applicants in this processing round require far more than $1/N$ of the spectrum available (where “N” is the number of licensees),¹⁷ and would not be economically viable with such limited bandwidth. This is particularly the case given the Commission’s decision to eliminate certain secondary allocations to NGSO FSS in the Ka-band.¹⁸

Although, under the Commission’s proposal, additional spectrum *may* be available to individual licensees, there is no assurance that this will be the case. Further, the availability of this unused spectrum will decrease over time, as new systems enter service. Thus, at precisely the point at which the earliest entrants are beginning to load their systems to full capacity, they will face a reduction in available bandwidth. This situation creates substantial business uncertainty that can significantly inhibit the financing of these systems.

Moreover, the proposal could easily thwart efficient use of the spectrum, by hindering coordination among NGSO FSS systems, which could yield far greater capacity from the limited spectrum. This is because, depending on the design of its system, an operator could have a strong disincentive to allow sharing of its exclusive spectrum and/or the unused spectrum, even if such sharing is technically feasible and would not unduly hinder its own operations. Granting exclusive spectrum rights to individual operators is simply an invitation to those operators to protect those rights. Moreover, considerations such as business competition could encourage a system not to

¹⁷ The final number “N” will not be determined until the Commission adopts all of the technical and service rules for these systems and applies those rules to the various applications, including any amendments thereto. The number N could be as high as six (Teledesic plus the remaining five second round applicants).

¹⁸ See NPRM, ¶ 10.

coordinate with another system to permit use of unused spectrum. Maximum use of the spectrum could be achieved only if all of the operators have an incentive to agree not to exercise their exclusivity rights and instead agree to coordination.

Furthermore, this proposal is not technology neutral, and would impose specific requirements on systems that hope to employ more than $1/N$ of spectrum. Such systems would have to be built to operate over greater bandwidths than they may ever be permitted to use, while still remaining capable of operation within any given $1/N$ of the spectrum. In other words, two very different modes of operation would have to be planned for, due to the regulatory uncertainty inherent in Option I. Such systems would have to be capable of frequency diversity,¹⁹ so that they could adapt to repeated changes in frequency plans. Even operators that redesigned their systems and business plans to operate in only $1/N$ of the spectrum would have to be prepared for the possibility that, by the time they launch, another system will have already claimed the spectrum for which they had optimized their system.

Finally, Option I could create conflict with sharing regimes adopted by other countries. Other administrations could adopt more spectrum-efficient solutions based upon co-frequency sharing among the systems, using any of a variety of interference mitigation techniques. A U.S. system optimized to operate in its reserved piece of spectrum without the need to mitigate interference to other NGSO systems could have difficulty operating within such a regime, and its ability to offer global services would suffer dramatically. The additional cost for the systems to be adapted to various sharing regimes could be very high. They would be forced to implement operational flexibilities to accommodate the different sharing regimes, which would not only defeat

¹⁹ In this context, “frequency diversity” refers to the agility of a system to change the frequencies used by its various communications links.

certain advantages of band segmentation, but could also thwart the Commission's objective of a technology-neutral solution.

B. Option II – Dynamic Band Segmentation

Unlike Option I, the Dynamic Band Segmentation approach of Option II would allocate the spectrum at any given time only among the operating systems. Thus, the first system would be entitled initially to use all of the allocated spectrum, and as each new entrant commences service, the number of individual spectrum assignments would increase. With the launch of each new system, each existing operator would be required to surrender use of a portion of the spectrum to which it previously had access. Priority in choosing slots would be based on the date each licensed system becomes operational.²⁰

This proposal suffers from essentially the same problems identified with respect to Option I above. While it may provide early entrants a temporary guarantee of access to greater spectrum than under Option I, it does nothing to guarantee continued access to adequate spectrum as the system matures: i.e., when the need for maximum spectrum (capacity) most likely is greatest. It would also impose on operators design constraints that may not be compatible with the goals of their systems or with the underlying purpose of band segmentation. As with Option I, it would require operators to implement frequency diversity in order to: (i) benefit from more than 1/N of the spectrum and/or operate in any of the possible slots;²¹ (ii) coordinate with other systems; and (iii) accommodate other international sharing regimes.

²⁰ NPRM, ¶ 23.

²¹ Moreover, even though the Commission states that operating systems would have priority in choosing slots as new systems commence service, in contrast to Option I, even an early entrant may be forced to adopt a new frequency plan with each new entrant. For example, a third entrant that is using the center 1/3 of each sub-band would not only lose spectrum with the entry of the fourth system, but would have to migrate its operations up or down in frequency at the same time.

C. Option IV – Homogeneous Constellations

Option IV, in its simplest form, is premised on the adoption by the Commission of a single permissible NGSO constellation design, so that all of the operating systems would be homogeneous.²² While the use of similar orbital and transmission parameters would allow systems to operate co-frequency without suffering from in-line events, this option fails to meet numerous Commission goals in this proceeding.

Most importantly, it is not technology neutral. It would take critical business and technical decisions away from the marketplace and force the Commission to make such determinations. As noted by the Commission in the NRPM, the pending NGSO FSS applications represent a wide range of constellation designs.²³ Each design is unique and optimized for specific requirements dictated by the operator's goals for the system. A constellation design is the result of many trade-offs involving technology availability, cost targets, service and performance requirements, as well as business plan objectives. No matter which design the Commission selected, the inescapable result would be to render completely worthless the technical and business plans of the majority, if not all, of the other applicants.

Furthermore, there is no rational criteria upon which the Commission could select a "winning" design for U.S. systems according to any of the objectives articulated in the NPRM. The selection process would need to assess the overall merits of each project, or to determine a priori the relative performances of the business plans. Even among a given class of system (i.e., LEO, MEO, HEO), there are endless variations

²² NPRM, ¶ 33.

²³ NPRM, ¶ 34.

that would lead to the need for the Commission to make arbitrary decisions that may favor one applicant over the others.

As described further below, the selection of a required constellation design would constrain operators toward certain classes of services, for which the chosen constellation is optimized. As a result, the operators may not be able to bring to the market innovative services that depend on features not incorporated into the chosen architecture. Moreover, existing systems would have a de facto competitive advantage over new entrants. While operating systems would benefit from an installed customer base, the new entrant would not be bringing into service any significantly different technology or service. The business opportunity of a new entrant would be very reduced, further leading to less competition among NGSO operators and less benefits for the end-user.

Finally, SkyBridge shares the Commission's concern regarding the usefulness of enforcing homogeneous design once the possibility of non-U.S. systems is taken into account.²⁴ Orbit planning of this type has been rejected on numerous occasions in the ITU-R working groups, including by the U.S. delegation. Therefore, homogenous U.S. systems may be obligated to share with non-homogeneous foreign systems. Because homogeneity is a substitute for implementation of generic interference mitigation techniques, the U.S. systems could experience substantial difficulty accepting the sharing burden in the coordination process with a foreign system, putting in jeopardy their global operations. If, on the other hand, they invest in system flexibility in anticipation of such a requirement, even the marginal alleged benefits of constellation homogeneity would be lost.

²⁴ NPRM, ¶ 36.

The NPRM's proposed variations on this approach would involve either:

(1) adopting more than one “government-approved” constellation design, and dividing the available spectrum among the selected classes of systems; or (2) reserving some spectrum for systems that choose not to adopt the approved constellation design(s).²⁵

These solutions suffer not only from many of the problems identified above, they compound those problems by guaranteeing that many operators would not have access to the amount of spectrum needed to support their constellations and business plans.

SkyBridge urges the Commission to reject such hybrid approaches.

D. Option III – Avoidance of In-Line Interference Events

1. General Considerations

Option III – Avoidance of In-Line Interference Events – essentially applies the band segmentation concept of Options I and II *only* when in-line or near in-line events occur (i.e., when high interference levels occur) between satellites of two or more systems. This takes advantage of the antenna discrimination inherent in all of the proposed NGSO FSS system designs. In all other configurations (i.e., when the angular separation between the constellations is large enough to protect the receivers), the entire spectrum can remain available for the simultaneous use of each system. This technique maximizes use of the spectrum, because access to the entire allocated band is reduced only when high-level interference configurations occur. And when such configurations do occur, band segmentation only involves the affected satellites, maximizing the amount of spectrum that can be used at all times, and hence the capacity and economic viability of the systems.

²⁵ Id., ¶ 33, 35.

Moreover, this interference-avoidance technique can be applied in a completely generic manner, and does not impose significant design constraints on the various systems. As SkyBridge has explained elsewhere, while implementation of satellite diversity and frequency diversity can allow systems to further maximize the amount of spectrum available to them during in-line events, use of such techniques is not required with Option III.²⁶ This option truly gives each licensee the freedom to operate as closely as possible to its preferred design.

Furthermore, this interference-avoidance technique offers full regulatory and business certainty. The Commission need not involve itself in administration of the regime once the framework is specified, and each operator can predict with great certainty the amount of spectrum it will have available to it throughout the life of its system.

At the same time, this option encourages development among individual operators of even more efficient coordination agreements, based on the individual characteristics of their systems. Indeed, the approach closely resembles the first steps taken in crafting such agreements, and can easily be fine-tuned in bilateral (or, in exceedingly rare instances, trilateral) agreements among the various operators to better meet their needs. This is in stark contrast to the other options, which place licensees in an artificially constrained sharing framework, interposing numerous barriers to achieving a coordinated solution that would optimize spectrum access and efficiency.

Option III also eliminates a number of the concerns expressed by the Commission in the NPRM. For example, it best prepares the U.S.-licensed systems to

²⁶ See, e.g., SkyBridge Ku-Band Comments at 17, n.36; SkyBridge Ku-Band Reply Comments at 5-6. To the extent applicable to the instant proceeding, these documents are incorporated herein by reference.

face different sharing regimes in different countries. It encourages systems to incorporate the ability to use mitigation techniques into their systems, because these techniques can help them to increase capacity even in the U.S. These capabilities can then be used to adapt to other sharing regimes that may be adopted by other countries. The other options, however, discourage development of such techniques, because they may be of limited use in the U.S. Indeed, band segmentation and the use of homogeneous constellations are designed specifically to avoid the need for such measures.

In sum, Option III would provide each entrant equal access to the spectrum, without requiring permanent and systematic reduction of the spectrum available to each operating NGSO FSS system, as is the case under Options I and II. Furthermore, Option III does not require operators to make fundamental system design changes that would sacrifice their technical and business plans, as is the case with Option IV. In fact, *Option III is the only option that meets every one of the Commission's objectives summarized in Section I above.*

2. **Implementation**

The implementation of Option III has been discussed in detail in previous SkyBridge filings in other proceedings.²⁷ As SkyBridge has explained, two elements need to be defined to implement the technique: (1) the definition of “in-line” event; and (2) the spectrum-sharing arrangement to be implemented during in-line events.

With respect to the definition of “in-line event,” there are many approaches that can be taken. The simplest is to select, in a somewhat arbitrary fashion, a benchmark angular separation between NGSO FSS constellations. Separation below that

²⁷ See SkyBridge Ku-Band Comments at 18-21 and Annex 1; SkyBridge Ku-Band Reply Comments at 12-16; SkyBridge March 27, 2001 *Ex Parte* at 11-17; SkyBridge January 31, 2002 *Ex Parte* at 15-32. To the extent applicable to the instant proceeding, these documents are incorporated herein by reference.

threshold would then constitute an in-line event. In the Ku-band proceeding, SkyBridge proposed a value of 10° for this value, because it would be large enough to ensure protection of the main-beams of the terminals (without overburdening system operations), while still being sufficiently large to encourage coordination.

However, SkyBridge also noted that some accommodation would have to be made to take into account the significantly different power levels of certain systems.²⁸ For the Ku-band case, SkyBridge proposed a simple algorithm for implementing a larger separation angle for the case of “high-power” uplinks²⁹ (uplinks using significantly higher power levels and higher off-axis gain than those of other systems).³⁰ That algorithm depends on both the on-axis EIRP and the off-axis EIRP of the system earth stations.³¹ Such an approach could be developed for Ka-band sharing as well.

On the other hand, more rigorous approaches, which pre-select more optimum angular separations between the various constellations, also are possible. Such approaches can take into account the link budget and performance objectives of the NGSO FSS systems. In the Ku-band proceeding, SkyBridge proposed an approach that defines an in-line event based on the threshold for synchronization loss of each link under clear sky conditions.

²⁸ In general, a limitation on the on-axis and off-axis e.i.r.p. of the terminals, or an increased angular separation between certain constellations, could be employed for this purpose.

²⁹ In the Ku-band, use of higher power by some systems is not an issue on the downlink. The EPFD limits constrain all systems to similar power levels.

³⁰ See SkyBridge January 31, 2002 *Ex Parte* at 22.

³¹ As SkyBridge explained, both EIRP levels are important because a terminal with a relaxed antenna pattern may not adversely affect other systems if its power is low (which may be the case for a LEO), while a terminal with a high on-axis power (such as a MEO or HEO) may not adversely affect another system if its antenna performance or diameter is high. *Id.* at 23.

Under this approach, an in-line event occurs as soon as the synchronization of the victim link is lost due to interference from another system, as generated by an in-line satellite. In this way, the victim system is protected from harmful emissions from the interfering system, and the interfering system is required to protect the other system only when it creates harmful interference. At the same time, this arrangement constitutes a very “rough” coordination, which provides an incentive to engage in a more refined bilateral coordination. Because it ensures that no link is broken, it permits systems to operate co-frequency, while encouraging operators to improve their common interference environment.³²

In addition, in order to balance the sharing burden, SkyBridge has proposed that the performance objectives of the victim constellation be taken into

³² In the NPRM, the Commission seeks comment on the applicability of the GSO FSS coordination trigger to an Option III sharing regime. NPRM, ¶ 29. As SkyBridge and others explained in the Ku-band proceeding, the coordination threshold that applies to GSO FSS inter-network interference limits is not directly applicable to NGSO FSS networks. NGSO FSS systems are characterized by multiple satellites whose positions move with respect to the earth and with respect to satellites of other systems. The interference environment created by such systems is therefore very dynamic, as opposed to the static environment created by GSO systems. Any interference criteria must account for the time-varying nature of the inter- and intra-system interference. Furthermore, NGSO systems have essentially global coverage, and in most cases their links must be optimized for operation over all the rain zones and a wide range of elevation angles. Therefore, most NGSO systems employ adaptive coding of some sort, and their capacity is dependent on the margin against rain fade or low elevation. This adaptive margin can therefore be used for interference mitigation. All NGSO FSS systems will have the capability to cope with higher interference levels for short periods of time. For these reasons, a 6% $\Delta T/T$ trigger, as used for GSO/GSO coordination, can lead to unnecessary coordination in the NGSO context, and an inefficient use of spectrum resources. The SkyBridge approach for defining in-line interference events based on the I/N threshold for synchronization loss takes into account the time-varying nature of NGSO interference and the ability of NGSO systems to withstand short periods of interference, so long as synchronization loss does not result.

account.³³ To do so, it is necessary to establish a level of increased unavailability that is considered acceptable by a particular system. A series of trial and error simulations will determine which angular separation generates the unavailability increase based on the synchronization loss threshold. Further details are provided in previous SkyBridge pleadings, which are incorporated herein by reference.³⁴

With respect to the value of the unavailability increase that should be permitted, the Commission seeks comment on Teledesic's proposal in the Ku-band proceeding to employ a 10% aggregate allowance.³⁵ In fact, in Teledesic's proposal, the magnitude of the interference allowance depended on the number of operational systems.³⁶ SkyBridge opposed this approach, because the entry of a new system should not upset all the previous coordinations between other operators. While a new entrant will require previous entrants to take steps to implement Option III to handle in-line

³³ This is to guarantee that an interfering system is not required to over-protect a system with overly-sensitive links. Even with low interference levels, the performance objectives of a victim link may be seriously impacted if insufficient margins are implemented.

³⁴ See SkyBridge Ku-Band Comments at 18-21 and Annex 1; SkyBridge Ku-Band Reply Comments at 12-16; SkyBridge January 31, 2002 *Ex Parte* at 25-28. The basic steps of the approach are as follows: (1) determine the sync loss threshold of the victim system (I/N_{TH}); (2) select an initial value for the angular separation of the systems (starting with a small angle); (3) run a complete simulation generating the distribution of I/N levels created by the interfering system; (4) convolve the distribution with the rain fade distribution to get the total degradation distribution; and (5) compare the total degradation with the degradation due only to rain to determine the unavailability increase due to the interfering system. Finally, if the unavailability increase is greater than the predetermined threshold, a larger angular separation should be selected and the analysis repeated starting with step (3).

³⁵ NPRM, ¶ 30.

³⁶ Specifically, Teledesic proposes an interference time allowance of 10% of the time allowance for the BER specified in the short-term performance objectives assuming two systems, a 7% allowance assuming three systems, and a 5% allowance assuming four or more systems.

events with that new system, this should not require each existing system to significantly alter the steps already taken to handle in-line events with other existing systems.³⁷

SkyBridge therefore proposed to adopt a unique criterion, which would not depend on the number of NGSO operational systems. Consistent with Teledesic's proposal for three systems, SkyBridge selected 7% of the time allowance for the BER specified in the short-term performance objectives of the victim network.³⁸

Implementation of Option III also requires establishment of a spectrum arrangement during in-line events. At its simplest, the approach will require each system to know only the locations of the satellites of the other systems, and to confine automatically its transmissions to assigned portion of spectrum whenever the predictable in-line events with other constellations occur.³⁹ This is easily automated, because in-line

³⁷ Another difference between the Teledesic approach and the SkyBridge approach is Teledesic's use of the methodologies described in Recommendation ITU-R S.1323. While this approach is indisputably the most accurate, and is the preferred approach for full coordinations, it is far too complex for a *default* coordination solution. The methodology proposed by Teledesic would consume substantial time and computational resources. It requires use of very detailed and complex interference statistics. It is not appropriate for use as a default coordination, which may be a first step toward further coordination, or a final step when productive dialog among the licensees is, for whatever reason, not possible. SkyBridge has therefore proposed a simplified approach for use in the present context. SkyBridge's approach is sufficient to determine whether coordination is necessary between two systems, and if so, what angular separation must be maintained to avoid unacceptable interference during in-line events. This is all that is needed for the Commission's default solution. Individual operators may opt for more detailed coordination among themselves to further optimize use of the spectrum (perhaps using S.1323, for example), but this need not be required by the Commission's regulations.

³⁸ See SkyBridge Ku-Band Reply Comments at 14-15; SkyBridge January 31, 2002 *Ex Parte* at 26 (incorporated herein by reference).

³⁹ Each operator will have the option of employing system flexibilities to optimize its operations. For example, satellite diversity may allow an operator to hand-over traffic to another satellite just before an in-line event in order to be able to continue to employ all of the spectrum. Therefore, the complexity introduced by this approach is largely a function of the efficiencies the operator hopes to achieve. An operator that does not need access to all of the spectrum all of the time can employ very simple

events will be predictable in advance, and the pattern of events will be repetitive over time.⁴⁰

Each band segment will need to be split among two or more systems involved in a given in-line event. The splits can be established by default or priority (based on, for example, the date of launch of each system⁴¹). In addition, licensees should be permitted to agree among themselves to different splits based on individual preferences.

III. SERVICE RULES

A. Financial Qualifications

SkyBridge supports the Commission proposal not to implement a financial qualification standard for second round NGSO FSS systems in the Ka-band,⁴² assuming adoption of a sharing regime based on avoidance of in-line interference events (Option III). This is because, under Option III, all of the systems can be accommodated in the available spectrum, in a manner designed to ensure that the deployment of any given system will not depend on the extent to which other parties are ready, willing and able to proceed.

protocols. Operators that hope to make maximum use of the spectrum will require more complex switching strategies. In either case, the choice is entirely within the control of each system, based upon the flexibility built into that system and its specific spectrum requirements.

⁴⁰ The Commission asked how frequently the disclosed orbital elements of each NGSO FSS system, in NORAD format, would need to be updated to provide for effective sharing among these systems. NPRM, ¶ 27. In the Ku-band proceeding, SkyBridge proposed updates every 10 days, based on the stability of the NGSO FSS satellites at issue. That proposal is equally applicable to the Ka-band. See Petition for Reconsideration of SkyBridge, ET Docket No. 98-206, RM-9147, RM-9245, March 19, 2001, at 37, n.79 (incorporated herein by reference).

⁴¹ See, e.g., NPRM, ¶ 28.

⁴² NPRM, ¶ 38.

This is not necessarily the case with the other sharing methods raised in the NPRM. Options I and II have the potential to leave operating systems uncertain about long-term spectrum availability, with no countervailing technical, business or public interest benefit. With Option IV, the "model" system may never even launch, thwarting the entire basis of the sharing plan (not to mention thwarting the entire technical/business plans of the other applicants). If the Commission adopts any of these sharing regimes, it should impose the traditional, strict financial standards on all applicants.

B. Implementation Milestones

The considerations noted above with respect to financial qualifications apply to some extent to the need for implementation milestones. In other words, if Option III is implemented, delays in the build-out of one system will not adversely affect the build-out and operation of other systems.

However, SkyBridge has long supported milestones as necessary to ensure that the ultimate usage of the band is ascertained early in the deployment process. This will permit those operators ready, willing and able to put the spectrum to use to do so without lingering uncertainties caused by applicants that chose to sit on their rights.

SkyBridge could support rules and timelines consistent with those already applied by the Commission in analogous contexts, including those proposed in Appendix B of the NPRM.⁴³ However, the NPRM itself proposes a more interesting approach, *i.e.*, tying the milestones to the ITU "bringing into use" rules.⁴⁴ As highlighted by the Commission, the ITU already oversees a system that functions to ensure that operators

⁴³ Id., ¶ 40.

⁴⁴ Id., ¶ 41.

that do not proceed to expeditiously build-out their systems do not impede the progress of other systems seeking to use the same spectrum and/or orbital resources. Much regulatory simplification could be achieved if the U.S. rules were tied to the ITU timelines. In fact, if this is not the case, either the U.S. or ITU rules become irrelevant, because the licensee will need to follow whichever regime is the most strict. SkyBridge therefore supports rules conforming to the relevant ITU requirements.

C. Reporting Requirements

SkyBridge supports the Commission's proposal to require annual reports from licensees describing the status of satellite construction and anticipated launch dates, including any major delays or problems encountered. SkyBridge also agrees with the Commission's proposal not to require reports of satellite outages, because with NGSO FSS systems, such outages are not likely to be used to warehouse spectrum.⁴⁵

D. Orbital Debris Mitigation

SkyBridge shares the Commission's concerns regarding orbital debris, and generally supports the requirements that were imposed on the 2 GHz MSS licensees.⁴⁶ Furthermore, the Commission notes in the NPRM that it plans to commence a separate rulemaking proposing to adopt similar requirements for all Commission-licensed satellite services, and SkyBridge generally would support application of such requirements to Ka-band NGSO FSS systems.⁴⁷

⁴⁵ Id., ¶ 42.

⁴⁶ Id., ¶ 43.

⁴⁷ Id. SkyBridge notes that the referenced orbital debris rulemaking recently was initiated by the adoption of a Notice of Proposed Rulemaking, FCC 02-80, IB Docket No. 02-54, released March 18, 2002.

E. System License and License Terms

SkyBridge supports the Commission's proposals to provide a blanket license for all technically identical satellites, and adopt a 10-year license term, running from the date on which the first space station in the system begins transmissions.⁴⁸

SkyBridge also agrees with the Commission that the current policy for system replacement applications is appropriate, and should be applied to Ka-band NGSO FSS systems.⁴⁹

⁴⁸ NPRM at ¶ 44.

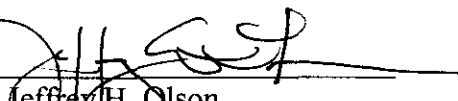
⁴⁹ Id.

CONCLUSION

The Commission should adopt sharing rules for Ka-band NGSO FSS systems that provide business and regulatory certainty that all licensees will enjoy equal opportunities to build and launch their systems, as designed in accordance with their individual business plans, with access to sufficient spectrum for broadband applications. Of the Commission's proposals in the NPRM, only Option III meets these important goals, and SkyBridge urges the Commission to proceed expeditiously to implement that approach.

Respectfully submitted,

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